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MY INTUITION WORKS, SO WHY MESS WITH THIS DECISION ANALYSIS STUFF

CAPTAIN JEFFREY R. STONEBRAKER
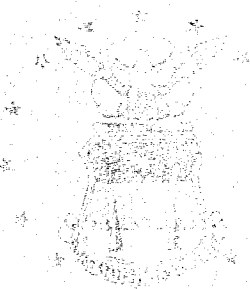
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This report describes possible shortcomings of unaided decision making and benefits of decision analysis. The premise of this report is that unaided decision making only works for simple decisions, but rarely suffices for complicated decision problems.

Unaided decision making is a holistic approach using the decision maker's intuition and heuristics. Unaided decision making can result in biases and systematic errors.

Decision analysis is a systematic process with the objective to provide insight and aid a decision maker in making better decisions by being consistent and logical. Decision analysis is a modelling process that quantifies uncertain information using probability theory and risk using utility theory. Decision analysis involves decomposing the decision problem into manageable pieces and then recombining the information as the expectation of probabilities and utilities.

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"My Intuition Works, So Why Mess with this Decision Analysis Stuff"

by Capt Jeffrey S. Stonebraker, Assistant Professor
Department of Mathematical Sciences
U.S. Air Force Academy

1   Introduction

... as soon as you begin to examine how people make decisions in their everyday lives, one fact becomes obvious: We do not always (in fact, we rarely) make the best possible decisions given our long-term goals (or at least given what we claim our long-term goals to be). (Rachlin, 1989, pp. 233 & 234)

How many times have you been faced with a tough decision because of the uncertainties and conflicting preferences involved? Throughout your personal and professional life you will be faced with a myriad of complex decisions involving uncertainty and competing preferences. How you approach these decision problems depends upon your experiences, creativity, and education. The purpose of this paper is to improve your understanding of how to approach complex, dynamic decision problems. The approach in attacking these decision problems is called **decision analysis (DA)**. In general, DA is a systematic process with the objective to provide insight and aid a decision maker in making better decisions by being consistent and logical. To quote Keeney (1982):

Decision analysis is the formalization of common sense for decision problems which are too complex for informal use of common sense. (p. 806)

In the next sections, are necessary definitions and distinctions; problems with unaided decision making; what DA is; and a conclusion.

2   Definitions and Distinctions

Decisions normally require a decision maker to use his or her judgment to commit scarce resources towards one alternative while at the sacrifice of other alternatives. Alternatives are choices or courses of action. Howard (1980) provides a concise definition of decision making.

Making decisions is what you do when you don't know what to do. (p. 4)

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A decision maker is the one who exercises such authority. Generally, decisions are based on preferences and information. Preferences are the desires or wants of the decision maker, for example, most decision makers prefer more money to less money. Information is what the decision maker knows about the particular decision problem. Information can be either deterministic or stochastic. Deterministic is known information or objective data, while stochastic is uncertain or subjective data. Properly implemented DA has the ability to model both objective and subjective data.

There is one absolutely critical distinction between a decision and an outcome. Outcomes are the possible consequences of your decision. Some of these outcomes can be desirable, while others are undesirable. For example, if you decided to play the lottery and bought $500 worth of tickets and you won a million dollars, then you had a very desirable outcome, but was this a good decision? In contrast, was it a good decision if you play the same lottery (and spent $500) and didn't win? One thing, for sure, the first example resulted in a good outcome, while the second example resulted in a bad outcome.

A good decision is logical, defensible, and rational. What does it mean to be rational? Rational is adopting a set of axioms and then being consistent with the axioms (Watson and Buede, 1987). Axioms are self-evident truths that describe what a person should do if faced with a simple situation, but as the decision problem becomes more complex or unclear, then the axioms no longer describe human behavior (Slovic, Fischhoff, and Lichtenstein, 1977). Once this happens, the decision maker violates the axioms and behaves irrationally (Howard, 1983).

Figure 1 shows that a decision (represented by a square) can be either good or bad (assuming we can classify decisions as either good or bad). A good decision is logical, defensible, and rational, whereas a bad decision is irrational and not logical nor defensible.

Most people do not exercise the control they have in making decisions; normally they make decisions in an intuitive manner. Intuition is an instinctive, unaided response to a decision; the result of intuitive decision making is uncheckable logic. However, by using DA you can exercise control of your decisions by making them in a logical, consistent, and rational manner. Decision analysis does not remove judgment or belief but rather quantifies them so we can apply logic to them rather than leaving them in the decision maker's mind - untouched and uncheckable. To quote Sage (1981):

A person who makes judgments based on intuitive affect typically takes in information by looking at the "whole" of a situation rather than by disaggregating the situation into its component parts and acquiring data on the parts. (p. 655)

A more effective decision maker is one who decomposes the decision problem, then evaluates the problem in a logical process to arrive at a decision.
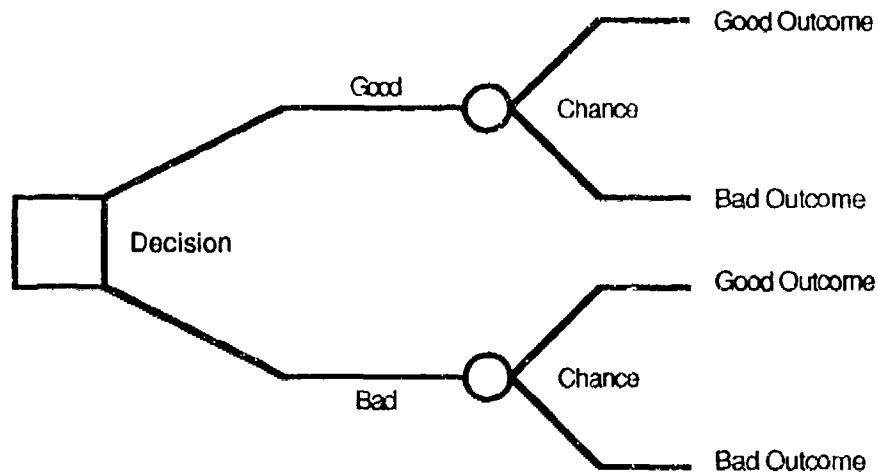
Figure 1. Decision versus Outcome Distinction

The outcome from a decision can be either good or bad. But, unlike the decision, you have little control of the outcomes because they are chance events, depicted as circles in Figure 1. The likelihood of good outcomes depends if your decision was good or bad. If you follow a logical, consistent, and rational process when making decisions, your likelihood of good outcomes will be much higher than if you make decisions in an ad hoc, intuitive manner. Decision analysis does not replace intuition, but rather blends the analytic and intuitive processes so that the analysis supports the decision-maker's intuition or provides information if contrary to intuition!

Decision making can be both descriptive and normative. Descriptive decision making is the way decision makers make decisions using intuition whereas normative decision making is the way decision makers should make decisions. Recall, a rational decision maker accepts and abides by a set of axioms when making decisions. These axioms are standards or norms; hence, the term, normative decision making. The primary purpose of DA is to guide and prescribe decision behaviors. The descriptive studies (Kahneman, Slovic & Tversky, 1982; and von Winterfeldt & Edwards, 1986) show decision makers violate normative decision making. Decision analysis bridges this gap between the descriptive and the normative. Decision analysis is a prescriptive process; it prescribes an approach by applying normative theory to a decision. Prescriptive decision making is concerned with helping decision makers make informed and better decisions (Keeney, 1989).

Another necessary distinction is the difference between strategic and tactical decisions. A strategic decision is a non-repetitive (unique) decision involving a long-term horizon. A tactical or operational decision (Kirkwood, 1990) is a lower-level decision involving routine changes in current operating characteristics of the organization to achieve better performance. A strategic decision maker is one who practices a "ready, aim, fire" approach. In

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comparison, a tactical decision maker is one who practices a "ready, fire, aim" approach. This paper concentrates on strategic decisions.

3   Problems with Unaided Decision Making

During a recent night-time plane trip from Colorado Springs, Colorado to Dayton, Ohio, I was relieved to find out that the pilots on board were flying by instrument and not relying on feeling. During inclement weather and at night, pilots normally fly by wire (or instrument) rather than by sight and instinct. This epitomizes the precept of a good decision. To achieve this goal of a good decision, decision makers should use a logical, consistent, and rational approach when faced with complex decision problems rather than relying on feeling or intuition. Intuition only survives when the decision is clearly illuminated.

Typically, the initial decision situation facing the decision maker is one of confusion, complexity, and uncertainty. Each decision maker makes decisions in varying degrees of sophistication. In fact, people use different decision-making strategies when faced with different task demands (Payne, 1982; and Johnson & Payne, 1985). Some decision makers go into great detail and effort in making decision; however, most decision makers approach decisions in an ad hoc, holistic manner relying completely on intuition. In some cases, intuition will provide acceptable results. In general, these cases usually include repetitive and static decisions. Normally, the decision maker has no clear alternative, but has many conflicting and competing alternatives. How the decision maker reacts to such a situation depends on the decision maker's experience and training. Some decision makers will break down the problem into manageable pieces, while others are overwhelmed and merely guess, i.e., go with their instincts. Decision analysis provides the decision maker a framework (McNamee and Celona, 1987) to properly manage such a situation.

As the complexity in a decision increases, the objective data available decreases, thereby forcing the decision maker to rely more on judgments. Judgments are subjective opinions or beliefs based on experience, knowledge, and rational thought. Also, complex decision problems can have an overabundance of information so that the decision maker can't facilitate all this information. Once the decision becomes too complex, the literature shows that making decisions by a holistic approach or intuition rarely suffices. A decision maker can not keep track of all the factors involved in complicated decisions.

When people are not aided by analysis and logic systems, their decision processes often suffer from inconsistencies in logic and biases in the subjective assessment of data. (Samson, 1988, p. 505)

Other terms synonymous with intuition include: common sense and heuristics (rules of thumb). Common sense and heuristics work well when there is little information available. However, once the decision problem becomes replete with information, then intuitive decision-making abilities become inadequate (Holtzman, 1989). Heuristics or rules of thumb are quite useful for

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simple decisions. However, once the decision problem becomes complex, heuristics can lead to systematic errors and biases in decision making (Edwards, 1961; Becker & McClintock, 1967; Rapoport & Wallsten, 1972; Slovic, Fischhoff, & Lichtenstein, 1977; Einhorn & Hogarth, 1981; and Pitz & Sachs, 1984). Some of the well known and documented heuristics (Tversky and Kahneman, 1974) include availability, anchoring and adjustment, and representativeness. In addition, Sage (1981) lists 27 biases found in a literature review of cognitive psychology studies where people apply various intuitive strategies leading to flawed prediction, forecasting, and planning. Because of the information explosion, and the complexity and uncertain nature of most decision problems, *the era of the successful intuitive decision maker is over* (Baird, 1989, p. xi). Complex decision problems involving uncertain information and competing preferences force the decision maker to make subjective judgments. Decision analysis (DA) can assist the decision maker by managing the complications in a clear and logical manner. In summary (Sage, 1981):

... most studies have shown that simple quantitative models perform better in human judgment and decisionmaking tasks, including information processing, than wholistic expert performance in similar tasks. (p. 648)

4 Decision Analysis (DA)

The existence of biases and errors in unaided judgments is part of the motivation for aiding the judgment process; the assumption is that aided judgments are less subject to error. The aid is based on a prescriptive formulation that decomposes the problem into its separate elements and presumably helps the decision maker to overcome the limitations of unaided judgments. (Pitz & Sachs, 1984, p. 155)

Many decision makers have a misconception of what DA is; DA is not a replacement for the decision maker, not a decision tree, not a black box or computer where you input numbers and the output is just a bunch of numbers, and not a rigid approach that provides the de facto answer to your decision.

Decision analysis is a systematic process with the purpose of aiding the decision maker, i.e., helping the decision maker make good decisions. The major players during DA include: decision maker and delegated subordinates who are the experts in the decision domain and a decision analyst who is an elicitor, formulator, and evaluator of the decision maker's preferences, but not necessarily an expert in the field of the decision (Howard, 1980). Normally, the decision maker and the analyst are not the same person. Decision analysis provides the decision maker with the necessary framework to make logical, defensible and rational decisions. Decision analysis prescribes a balance between the descriptive world of the decision maker and the normative world, see Figure 2. The descriptive world of the decision maker includes the decision maker's preferences and information concerning a decision. The normative world consists of axioms. A decision analyst balances these two worlds by prescribing the DA process. Decision analysis focuses the attention of the decision maker on the decision and aids in communicating the decision throughout the organization. Howard (1988) summarizes DA as follows:

... decision analysis: a systematic procedure for transforming opaque decision problems into transparent decision problems by a sequence of transparent steps. Opaque means "hard to understand, solve, or explain; not simple, clear, or lucid." Transparent means "readily understood, clear, obvious." In other words, decision analysis offers the possibility to a decision-maker of replacing confusion by clear insight into a desired course of action. (p. 680)
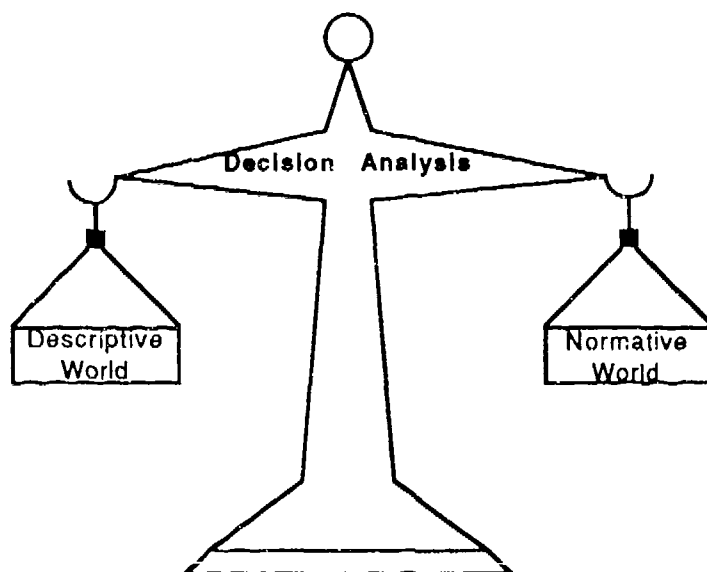

Figure 2. The Balancing Act

Decision analysis is a "divide and conquer" process involving decomposition and recomposition of all the decision factors. Decomposition allows the complex decision to be broken down into smaller, manageable pieces so that the decision maker can clearly understand the decision problem. This accomplished by dividing the information into finely and clearly defined pieces of information, which allow the decision maker to accurately describe an uncertain variable. This allows the decision maker to discriminate among uncertainties and better use the information available.

Why decompose? Breaking down the decision problem into smaller pieces allows the decision maker to use his/her subjectivity on a smaller scale rather than in a holistic manner. For example, multiply 4369 by 123 in your head. Tough to do if you approached the problem in a holistic manner. Now, dissect or decompose the problem by multiplying 1) 4369 by 100, 2) 4369 by 20, and 3) 4369 by 3 followed by "recomposing" (adding the results of steps 1, 2, and 3). This decomposing/recomposing process is a normative approach you learned in grade school. By breaking the problem into manageable pieces, one can do the multiplication. What applies to this simple multiplication problem also, applies to decision making. When faced with an uncertain, complex decision, the literature indicates that decision makers should decompose the decision into smaller pieces (Sayeki & Vespers, 1973; Fischer,

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1977; Shapira, 1981; and Pitz & Sachs, 1984) rather than rely on holistic measures. However, most individuals believe they can make good decisions in a holistic manner. Unfortunately, research in cognitive psychology refutes this statement (Lichtenstein and Slovic, 1971). Also, "Miller's law" (1956) illustrates that people are poor processors of information. The human mind can only "hold" seven, plus or minus two pieces of information. Simon (1957) reiterates the cognitive limitations of humans as follows:

The capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems whose solution is required for objectively rational behavior in the real world - or even for reasonable approximation to such objective rationality. (p. 198)

When humans are forced to make unaided decisions in a complex environment, human cognitive limitations produce biases, inconsistencies, and distortions. In summary, Slovic, Fischhoff, and Lichenstein (1977) best sum up unaided decision making as follows:

... a decade or more of research has abundantly documented that humans are quite bad at making complex, unaided decisions... (p. 22)

One of the key ingredients of decomposition is clearly defining the components of a decision problem which Howard (1989) calls the clarity test. We define the clarity test as follows: clearly defining all the decision factors so the decision maker and analyst have a common understanding of each decision factor. Decision factors include alternatives, outcomes, and likelihood of outcomes. Many times an unsuccessful DA can be ultimately traced back to failing the clarity test.

Decision analysis is not a checklist or a "plug & chug," mechanical procedure; it is a iterative and interactive process with the purpose of providing insight to the decision maker by illuminating the decision problem so that good decisions can be made. Decision analysis has four basic steps, namely: formulate, evaluate, refine, and decide, see Figure 3. These steps are not a static process, but a dynamic process where there is no "correct" solution but merely a recommendation based on model inputs. Decision analysis organizes or structures the decision-maker's thinking about a decision problem so that the choice reflects the decision-maker's beliefs about the likelihood of outcomes and preferences for those outcomes. The interaction between the analyst and decision maker is the key to a successful and credible DA.

Now, we will discuss each of these steps in a little more detail. Figure 4 shows that the formulation step is the foundation for the rest of the analysis. The saying, "garbage in, garbage out" applies to this step for without a good formulation, the DA effort is doomed. Formulation involves identifying the problem, gathering information, passing the clarity test, and making modeling assumptions. During formulation, the analyst elicits the decision factors from the decision maker. From this interaction, the analyst constructs a model of the decision problem. One of the most useful formulation tools developed for DA in recent years is the influence diagram (Howard and Matheson, 1981). The influence diagram transforms opaque decision problems into transparent

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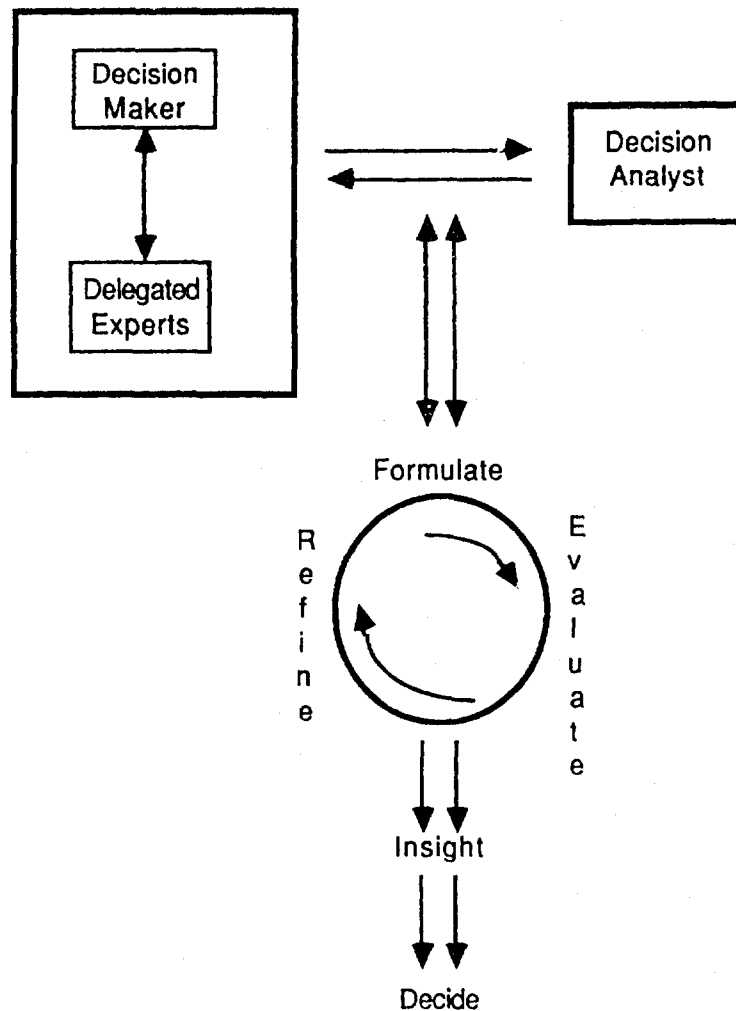decision problems by providing the decision maker with a clear visual formulation of the decision problem.

Figure 3. DA: The Iterative, Interactive, and Insightful Process

The model's complexity depends upon the decision and the decision ... are necessary to keep the model simple enough to be understandable, but robust enough to capture the decision-maker's preferences and information. Once the model is constructed, the analyst and decision maker will discuss the model and its implications. As shown in Figure 4, the formulation step is the most time consuming. Once the decision maker approves the model, we move into the next step, evaluate.

The evaluation step involves applying the normative axioms of DA in order to evaluate alternatives. Decision analysis is the application of decision theory to real-life decisions. Decision theory involves the theories of probability and expected utility. Probability is a measure used to describe a decision-maker's belief or state of knowledge concerning some unknown future outcome (uncertainty). Utility is a measure used to describe a decision-maker's desires,

wants, or preferences when facing risk. When faced with many alternatives the decision maker should select the alternative with highest expected utility. Expected utility is the weighted sum of probabilities and utilities associated with each alternative. To quote Watson and Buede (1987):

... decision theory requires us to express our uncertainties as probabilities and our attitudes towards risk as utilities, and to compute the expected utility to guide our actions... (p 82)
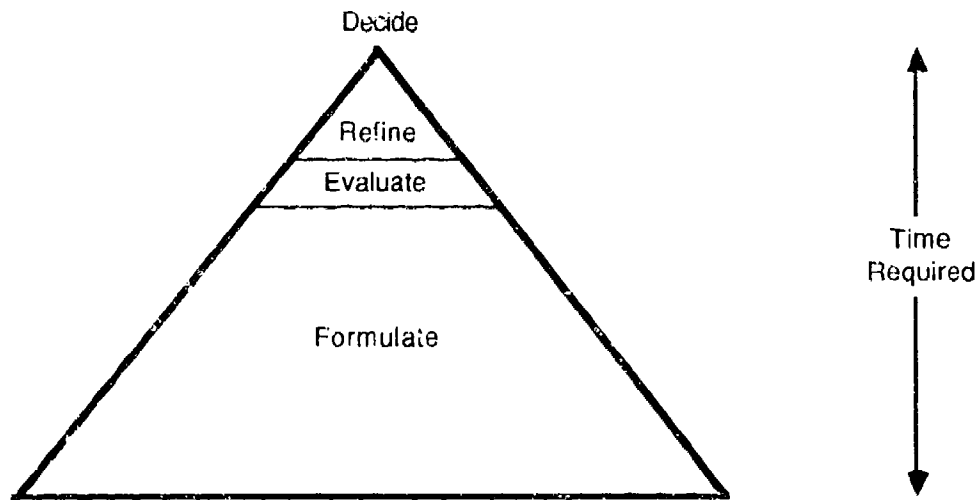

Figure 4. The Basic Steps of Decision Analysis

During the refine step, the decision maker can query the analysis effort to check the model's subtleties and precise distinctions. This is accomplished by sensitivity analysis. Sensitivity or "what if" analysis measures the effects of varying a decision factor in the model. Primarily, it is the refine step that makes DA cyclic. When new information is available or when the decision maker is not satisfied with the analysis effort, the analyst and decision maker can iterate back through any of the previous steps, thereby providing flexibility and promoting insight. The final step, decide, is when the decision maker pronounces judgment. The decision can mirror what the analyst recommends or the decision maker can decide another course of action that is more appropriate. This step leaves the decision maker with a great amount of flexibility. It is important to remember that DA is an aid to help the decision maker make better decisions and not the de facto answer. In summary, DA can be best summed up by a quote from Howard (1980):

... serves as a vehicle for focusing all the information of experts that the decision-maker may wish to bring to bear on the problem while leaving the decision-maker free to accept, reject, or modify any of this information and to establish preferences. (p. 7)

There is evidence (see previous sections) that a decision maker's cognitive abilities diminish as the decision problem becomes complex. But, does DA work? Management consulting firms such as Strategic Decisions

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Group, Decision Focus Inc., and Applied Decision Analysis Inc., to name a few, have been conducting decision analyses professionally for many years. Clients say that DA helps them. But, is that enough to say that DA works? According to Fischhoff (1980), these are insufficient reasons and someone needs to conduct a controlled experiment to see if DA works. With or without this experiment, DA is axiomatically justifiable in its theoretical foundations. However, once the interaction between the analyst and decision maker begins, then all bets are off. The normative appeal of DA shrinks because different decision analysts give rise to different representations of the decision-maker's preferences and information. BUT, as stated previously, DA is a modeling process used to aid the decision maker and not provide "the answer." Or, to quote Becker and McClintock (1967):

The models are not designed to describe how man ordinarily behave, but rather to help them behave more like they would like to behave. The models prescribe how to act if one is to be "rational." (pp. 240-241)

5   Conclusion

As mentioned previously, there are many advantages in using DA. These benefits are summarized below:

1. promotes insight
2. promotes communication
3. promotes flexibility for the decision maker
4. breaks the problem into manageable pieces
5. incorporates subjective judgments in the decision
6. illuminates the decision problem for the decision maker
7. helps the decision maker by focusing on the important issues
8. provides consistent, logical, defensible, and rational decisions

There are disadvantages associated with DA. Some disadvantages are that DA requires a

1. trained decision analyst.
2. considerable amount of effort and time.

Even though there are some disadvantages, applying **decision analysis (DA)** to your decision problems will help you make good decisions, thereby improving your chances for good outcomes.

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